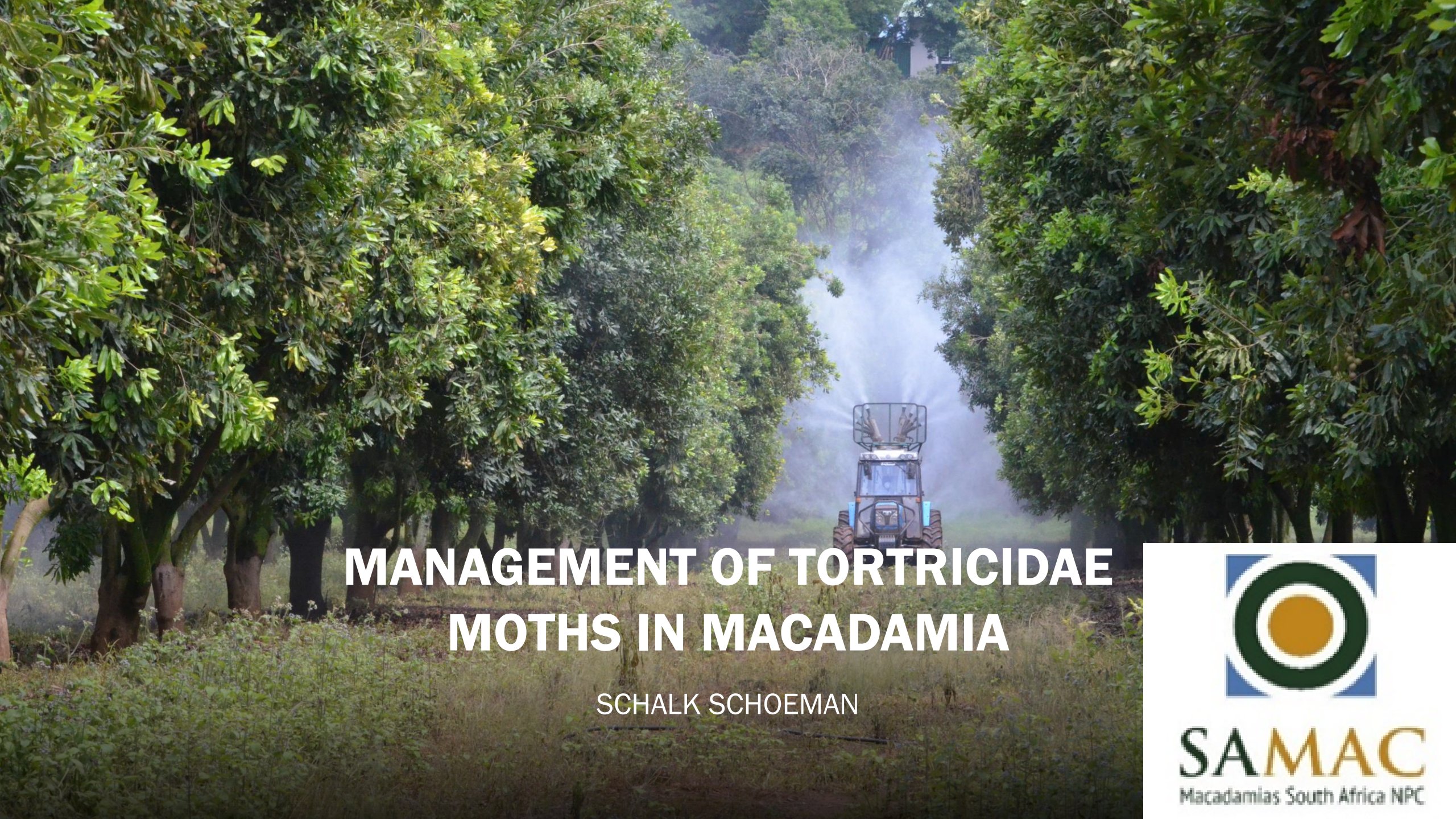


A blue tractor is seen from behind, driving down a dirt path in a macadamia orchard. The tractor is spraying a fine mist of pesticides from its rear nozzles, which fills the air and partially obscures the trees in the distance. The orchard is composed of mature macadamia trees with dense, green, glossy foliage. The ground is covered with dry grass and fallen leaves.

MANAGEMENT OF TORTRICIDAE MOTHS IN MACADAMIA

SCHALK SCHOEMAN



SAMAC
Macadamias South Africa NPC

PREREQUISITES FOR EFFECTIVE CONTROL

Correct product

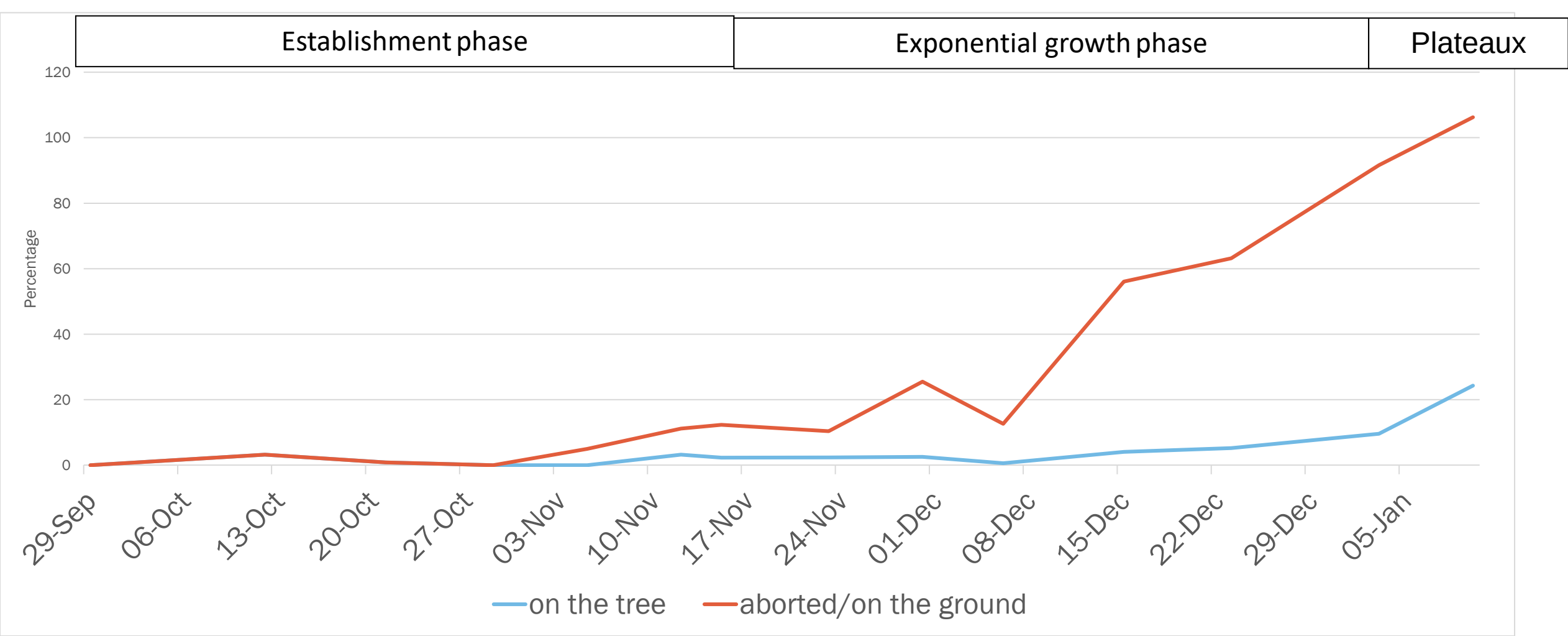
Optimal application

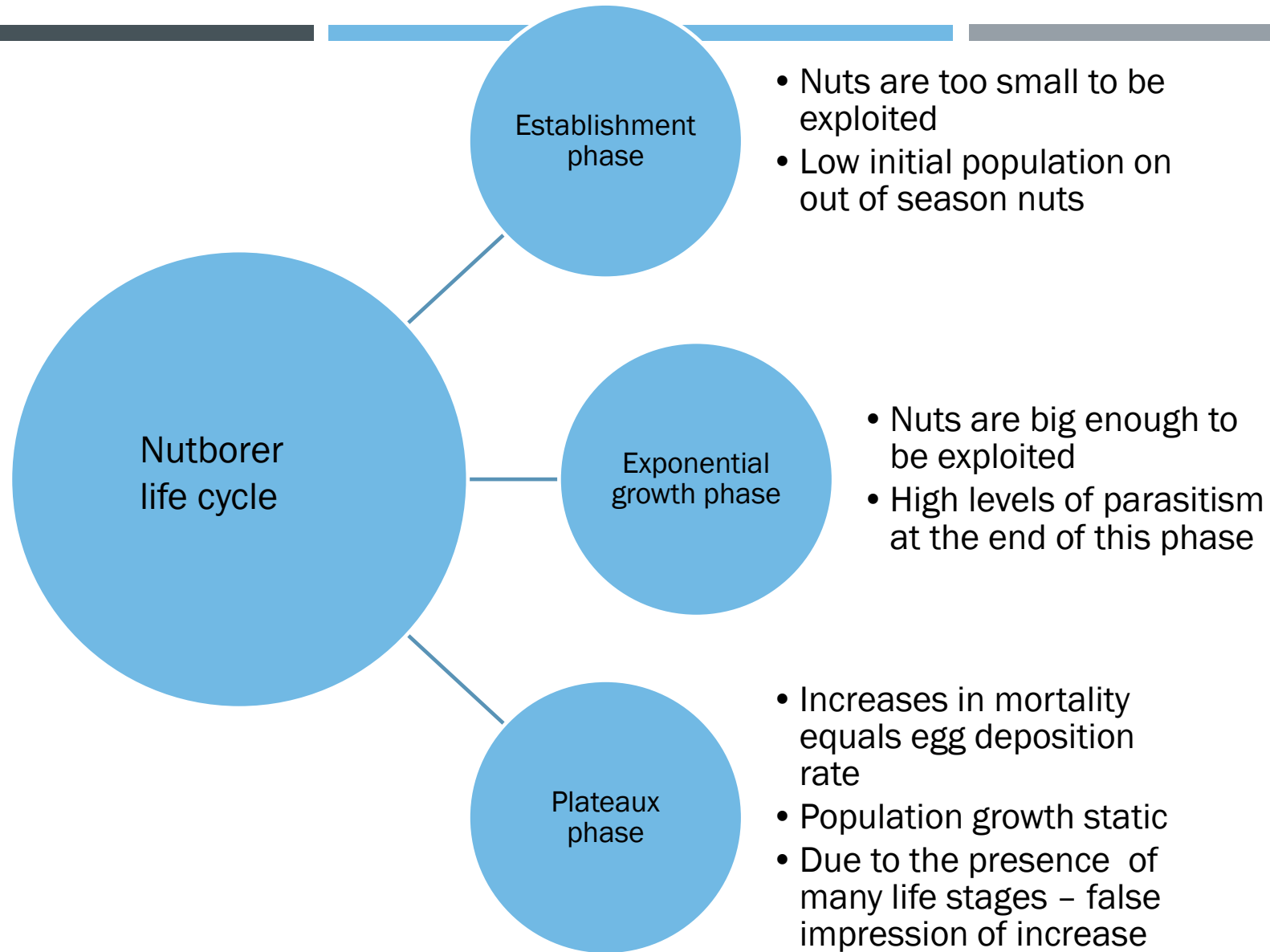
Synchronisation
with vulnerable
times in the biology
of the insect

SUMMARY OF RESULTS

Parameter	2021	2022
Number of orchards/farms evaluated	18	18
Number of nuts evaluated	9000	9000
Average infestation (%)	7.4	10.62
3 Worst farms (average)	21.2	34.7
3 Best farms (average)	2.06	1.06

POPULATION CURVE OF TORTRICIDAE NUT BORERS





Live eggs



Parasitized eggs





CASE STUDY I

- Old 344 orchard with a history of severe damage
- Orchard was very dense but alternative rows were removed
- Treetops were removed – regrowth still dense with poor spray penetration
- Weekly survey to quantify flowering, eggs and damage
- Pesticides applied very close to optimum
- Orchard surrounded by dense subtropical forest
- Pheromones were applied before oviposition peak

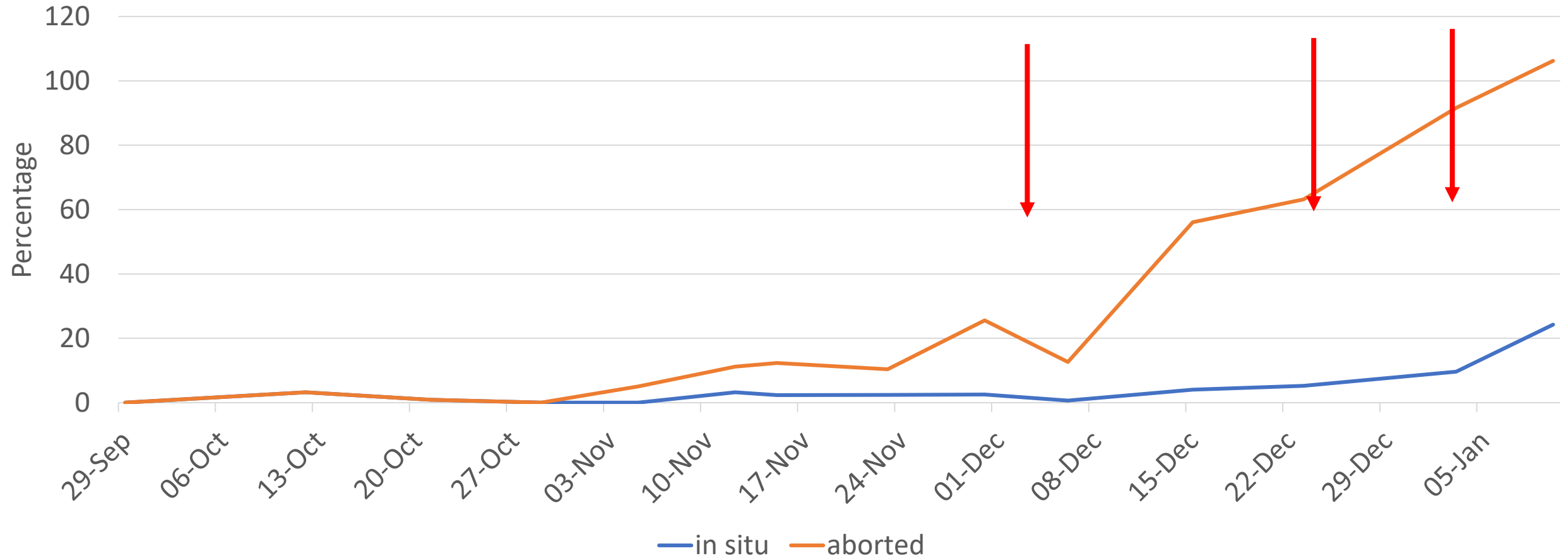
Parasitized (unhatched)



Parasitized and old



RELATIVE SEASONAL ABUNDANCE OF NUT BORER DAMAGE



ORCHARD COMPARISON ON THE SAME FARM

Dense old orchard

Identical spray program and timing

Cv. 344

Damage percentage = 24.27%
(nuts on trees) and 82% (nuts
on the ground) 10 January 2022

7 year old orchard – open well
maintained trees

Identical spray program and
timing

Cv. 816

Damage percentage = 1.2%
(nuts on trees) and no nuts on
the ground 24 January 2022

LESSONS LEARNT

- Acetamiprid/Bifenthrin applied during first week controlled the population to some degree but population quickly recovered and 2 subsequent applications of methoxyfenozide was not able to control the moths
- Pheromones for mating disruption did not work
- Eggs are laid considerably later than 9 weeks post flowering. The period around the first week in December seems to be the optimal window period for spray applications.
- Monitoring eggs and damage on fallen nuts is more accurate and reliable than on tree monitoring.
- These insects prefer dense, dark inner portions of the trees. Poor spray penetration in these areas will lead to poor control

CASE STUDY 2

- Old 816 trees
- Orchard was very dense but alternative rows were removed and orchard was pruned
- Methoxyfenozide applied very close to optimum
- During previous season - sprayer was totally inadequate
- During current season sprayer was significantly improved.
- Small farm - $\pm$ 10ha
- Regenerative farming principles applied



RESULTS

- 2021 season 12.8% measured on the 11th of January
- 2022 season 3.8 % measured on the 25th of January
- Changed the sprayer
- Sprayed approximately 3 weeks later based on scouting

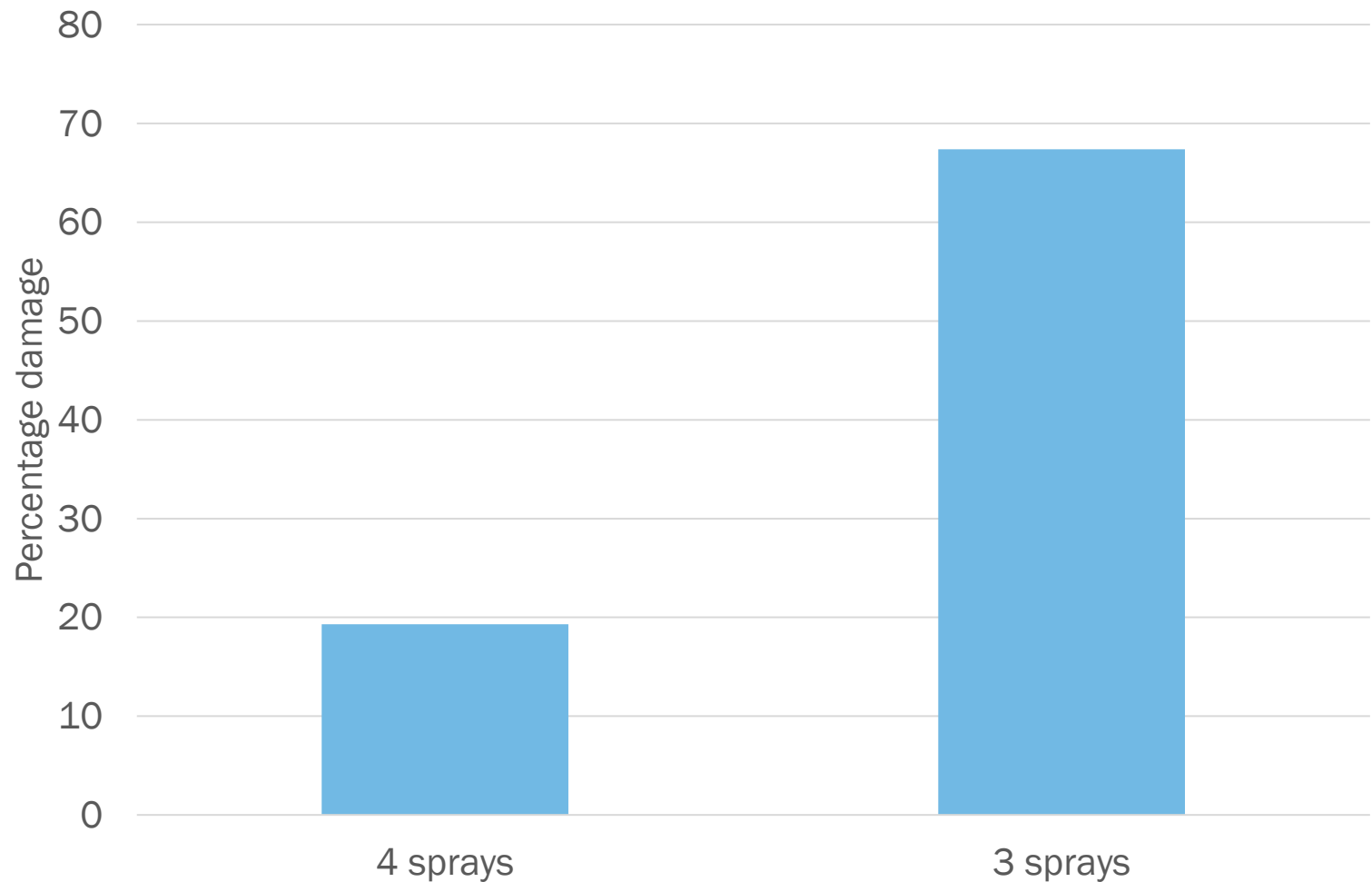
CASE STUDY 3

- Medium sized farm with tall dense vigorous trees (6 x 4 m = 417 trees/ha)
- CV. 816
- History of damage with 22.2% damage the previous season
- Spray timing and product choice was already optimal – no changes
- Prune
- Orchard floor spray with *Beauveria bassiana* during winter
- Sanitation
- Releases of 25 000 *Trichogramma* parasitoids/ha December and January
- Nut damage current season = 3.0% (n =1000 nuts)
28 January 2022

CASE STUDY 4

- Medium sized farm $\pm$ 60 ha
- Flowers damaged by cold - poor yield in low lying areas
- Cv. 816 9 year old trees
- Starting in November, orchards received 4 monthly sprays alternating between emamectin benzoate or methoxyfenozide.
- Due to low yield, the cold damaged orchard did not receive the early December spray

COMPARISON BETWEEN TREES RECEIVING EARLY DECEMBER SPRAY AND WHERE IT WAS WITHHELD



CASE STUDY 5

- Large farm $\pm$ 400ha
- Cv. 816 9 year old trees
- Damage 27 Jan 2021 = 20.6%
- Damage 26 Jan 2022 = 0.4 – 2.8% (nuts on tree visual examination)
- Damage 4.4% after nuts were harvested and dehusked
- Orchard floor treatment with *Beauveria bassiana*
- Pruning – good spray coverage
- Regenerative agricultural practices

COMPARISON BETWEEN PRUNED AND UNPRUNED TREES



CASE STUDY 6



- Medium sized farm –approximately 44ha
- Previous season good control with methoxyfenozide at the correct time – moth infestation 2,22%
- Trees were very vigorous and were not sufficiently pruned during the previous winter.
- Results during 2022 on the 17th of February – 16.6% moth damage

GENERAL CONCLUSIONS

- IPM is not a destination, it is a journey with many stops along the road.
- All farms differ and there is really not a specific cure-all that will sort out this complex of insects.
- Huge variation in data (1,2 – 67.4%) To put this in perspective damage ranged from $\pm$ R 1900.00 – 108 000/ha.
- Life cycle of these insects are complex – physiology of the plant will dictate behaviour of the insect
- Cannot treat these moths in the same fashion as stink bugs (spraying every time pre-set threshold values are breached – measured with yellow delta traps)

CONTROL RECOMMENDATIONS



- Would like to combine mating disruption with the application of registered contact insecticide.
- Methoxyfenozide is probably desirable for the critical spray during early December as it has both ovicidal and larvicidal activity
- Monitoring nut damage is critical.
- Monitoring on aborted nuts is more accurate as any damage to the nut during the early season will induce nut drop
- Pruning is critical as these insects prefer to feed in dark, dense parts of the trees. Spray coverage must therefore be optimal.
- Early December spray is very important and will contribute to at least 50% of pest levels

CONTROL RECOMMENDATIONS

- Sanitation is important and will lead to a reduction in pest numbers. Farm size is important as it may be difficult to implement in large farms
- Parasitoids are used for borer control in other parts of the world and should receive more attention.
- Orchard floor treatment with insect pathogens show promise and may lead to lower incidences of pest insects during the season.
- Monitoring multiple flowerings (magnitude as well as dates) is important as this will determine treatment strategy



IDEAL INTEGRATED CONTROL STRATEGY

- Prune orchard to ensure optimal light and spray mixture penetration.
- October Quantify dominant moth specie/region
- Deploy mating disruption pheromones or attract and kill products (when efficacy is sorted out)
- Last week in Nov – second week in Dec Spray a product with a long residual activity with preferably both larvicidal and ovicidal activities such as methoxyfenozide based on an exponential increase in aborted nuts with eggs/larvae (scouting) This could differ slightly between production regions
- Mid December – release a minimum of 25 000 Trichogrammatoidea parasitoids/ha to coincide with the synchronised oviposition peak as well as the Christmas break (these tiny guys will work when you are on holiday)
- Mid January – Release the second batch of 25 000 parasitoids/ha and continue monitoring for new eggs. Learn to distinguish between hatched/parasitised/live eggs. This is important as it will influence treatment strategy. Remove all aborted nuts from orchard and destroy. Spray if recently laid eggs are noticed
- Repeat



WHAT IS IPM?

